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through the Sun, was in longitude 168° 5′ 45″·7.* I may mention that Professor Oudemans has kindly informed me, by letter dated November 6, that with his $9\frac{1}{2}$-inch refractor, at Utrecht, he had a clear view of *Saturn* on the Friday morning and saw no ring, that Saturday (October 31) was overcast, and on Sunday morning he once, for a moment only, at 5^{h} 10^{m} A.M. (G.M.T), fancied he saw the ring through passing clouds, but Monday again was overcast, and he did not see the ansæ until Tuesday morning. His observations confirm the inference I had reported to him as derivable from my own views of *Saturn* on the mornings of Saturday, October 31, and Monday, November 2.

Murston Rectory, Sittingbourne:
1891 *November* 9.

Comparative Photographic Spectra of the Sun and the Metals. Series I. and II. By F. McClean, M.A.

I wish to lay before the Society two series of photographic spectra, in which the spectra of the Sun and of the fifteen metals enumerated are mounted in parallel sections, in order to facilitate their comparison and the identification of their lines. The spectra extend from wave-length 3,800 to wave-length 5,750 tenth metres, or from above (H) to near (D).

Series I. contains spectra of the Sun, iron, platinum, iridium, osmium, palladium, rhodium, ruthenium, gold and silver. The last eight constitute the platinum group of metals.

Series II. contains the spectra of the Sun, iron, manganese, cobalt, nickel, chromium, aluminium and copper. These seven metals constitute the iron-copper group.

Each series consists of six sections, corresponding to six sections of Ångstrom's chart.

The broad lines and bands which run uniformly across all the metallic spectra are due to the air. This spectrum is always present when the induction spark is taken between metal electrodes in the air. Its lines and bands are coarser, relatively to the other lines, than in the original negative. This is due to their prominence and consequent over-exposure in the negative. A special series of photographs are requisite to obtain the air spectrum relatively at its best, but as it is shown here it will bear comparison with the existing maps of it.

Before the true spectra of the metals can be arrived at, it is necessary to further eliminate the lines due to various impurities in the specimens of the metals employed as electrodes. Iron

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* Bessel's equations, corrected as above, give 168° 4′ 16″·1 as the longitude of the node for $1891\frac{5}{6}$. The difference seems probably attributable more to the unknown nutation of the ring, caused by all the satellites, than to the small disturbing precessional influence exercised by the Sun and *Iapetus*.

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appears in the spectrum of aluminium, and to a less degree in other spectra. Calcium is almost universally present, and becomes especially prominent throughout Section I. Its principal lines run with varying strength across nearly every spectrum, and coincide with marked groups of lines in the solar spectrum. The calcium spectrum appears most strongly in osmium and cobalt. The principal barium lines are also present in osmium, and its complete spectrum is no doubt present in Section I.

The beautiful fluting of lines in Section IV. of the aluminium spectrum, is attributed by Thalén to the oxide of aluminium formed in the aureole of the induction spark. The similar well-defined but less-marked fluting which occurs in many of the spectra in Section I. must be due to one of the constituents of the air. It cannot be due to calcium, as it is prominent in metals where calcium is absent.

The spectra of iridium, ruthenium, and rhodium, are, I believe, practically new work, and so I think are some of the other spectra, to the extent of Section I. and part of Section II.

The specimens of the metals of the platinum group which have been employed, were all obtained from Messrs. Johnson and Mathey, and were nominally pure.

The specimens of the metals of the iron group and most of the other specimens prepared for the further prosecution of the work have been obtained from Messrs. Hopkin and Williams. Some are nominally pure, but others, including aluminium, nickel, and cobalt, do not seem procurable in a pure state.

The identification of iron lines in the solar spectrum is, of course, evident. The identification of chromium, manganese, cobalt and nickel with weaker lines, can readily be made. It is impossible, however, to obtain any complete results from these two series of photographs alone. Photographs of the spectra of all the common oxidisable metals, and particularly of calcium, barium, magnesium and titanium, are first required; also duplicates of the present photographs are necessary in order to make direct comparisons between the separate spectra. The mounted photographs are being reproduced by the Direct Photo-Engraving Company. Specimens of four of the prints will be found along with the originals. The white lines unfortunately become a little coarser in the process.

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Mean Areas and Heliographic Latitudes of Sun-spots in the year 1890, *deduced from Photographs taken at Greenwich, at Dehra Dûn (India), and in Mauritius.*

(*Communicated by the Astronomer Royal.*)

The results here given are in continuation of those printed in the *Monthly Notices*, vol. l. p. 378, and are deduced from the measurements of solar photographs taken at the Royal Observatory, Greenwich, at Dehra Dûn, India, and at the Royal Alfred Observatory, Mauritius.

Table I. gives the mean daily areas of umbræ, whole spots, and faculæ, for each synodic rotation of the Sun in 1890; and Table II. gives the same particulars for the entire year. The areas are given in two forms: First, projected areas, that is to say, as seen and measured on the photographs, these being expressed in millionths of the Sun's apparent disc; and next, areas as corrected for foreshortening, the areas in this case being expressed in millionths of the Sun's visible hemisphere. Table III. exhibits for each rotation in 1890 the mean daily area of whole spots, and the mean heliographic latitude of the spotted area, for spots north and for spots south of the equator, together with the mean heliographic latitude of the entire spotted area, and the mean distance from the equator of all spots; and Table IV. gives the same information for the year as a whole.

Table I.

No. of Rotation.	Date of Commencement of each Rotation.	No. of Days on which Photographs were taken.	Mean of Daily Areas.					
			Projected.			Corrected for Foreshortening.		
			Umbræ.	Whole Spots.	Faculæ.	Umbræ.	Whole Spots.	Faculæ.
	d							
485	1890 Jan. 1·19	28	8·4	47·8	180	7·2	45·3	213
486	Jan. 28·54	27	0·8	3·3	54·0	0·5	2·2	71·8
487	Feb. 24·87	26	16·9	94·1	229	14·1	83·7	264
488	Mar. 24·19	28	0·8	8·7	45·9	0·5	5·5	52·1
489	Apr. 20·47	27	4·6	33·3	81·1	3·0	23·0	93·5
490	May 17·70	27	3·7	22·8	130	2·9	17·1	152
491	June 13·90	27	13·3	78·2	140	11·0	68·4	155
492	July 11·10	26	24·9	150	238	19·2	115	296
493	Aug. 7·31	28	59·0	394	142	36·3	241	156
494	Sept. 3·56	26	26·3	176	489	22·6	160	536
495	Sept. 30·83	27	47·7	316	604	36·2	247	598
496	Oct. 28·12	28	18·1	104	626	16·1	96·9	658
497	Nov. 24·43	26	60·9	344	520	38·4	224	644